

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE 2004	3. REPORT TYPE AND DATES COVERED Review Article - Nutrition Today		
4. TITLE AND SUBTITLE Going Against the Grain: Flaws in the Zone Diet			5. FUNDING NUMBERS	
6. AUTHOR(S) S.N. Cheuvront				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Thermal & Mountain Medicine Division U.S. Army Research Institute of Environmental Medicine Kansas Street Natick, MA 01760-5007			8. PERFORMING ORGANIZATION REPORT NUMBER MISC02/13	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Same as #7 above.			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT DISTRIBUTION STATEMENT A Approved for Public Release Distribution Unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) The Zone Diet is an eating plan claiming to maintain an "ideal" hormone balance and improve health through the manipulation of dietary carbohydrate and protein. While popular, the diet's health claims are based on dubious information, misinterpreted scientific facts, and it ultimately remains unsubstantiated.				
20040604 134				
14. SUBJECT TERMS eicosanoids, 40/30/30, low carbohydrate diet, hormone balance			15. NUMBER OF PAGES 4	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT	

Going Against the Grain

Flaws in the Zone Diet

Samuel N. Cheuvront, PhD, RD

The Zone Diet is an eating plan claiming to maintain an "ideal" hormone balance and improve health through the manipulation of dietary carbohydrate and protein. Although popular, the diet's health claims are based on dubious information and misinterpreted scientific facts, and it ultimately remains unsubstantiated.

The Zone Diet is an eating plan that claims to maintain "ideal" hormone balance and improve health through the manipulation of dietary carbohydrate and protein. Eaters are urged to consume a specific protein-to-carbohydrate ratio ($P:C = .75$) with each meal to reduce their insulin-to-glucagon hormone ratios and to trigger biologic events that ultimately produce permanent weight loss, reduce chronic disease risk, and enhance sports performance.¹⁻³ Total calories recommended on the Zone Diet are low, carbohydrate is approximately 100 g/day for sedentary people (40% of total energy intake),³ and low glycemic index foods are emphasized.^{1,2}

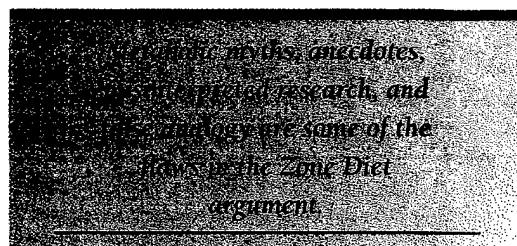
Nutrition quackery is the entrepreneurial promotion of any diet that restricts food choices, boasts of therapeutic benefits related to health and disease, and is unsubstantiated by modern science.⁴ The Zone Diet's formulation qualifies as modern nutrition quackery under this definition. Its rationale has been addressed and refuted in great detail elsewhere,^{3,5} but it continues to be popular.³ Like other popular low-carbohydrate diets, the Zone Diet is mass marketed to the public using claims (Table 1) that sound "scientific" but go against contemporary evidence-based nutrition science. This article provides a summary of the arguments used by Zone Diet proponents and the scientific evidence that refutes them.

Fundamental Flaws in the Zone Diet Argument

Zone Diet Proponents Endorse Metabolic Myths

Weight loss is not dependent on the composition of the diet as long as total energy intake is adequately reduced.⁶

Also, when energy intake exceeds energy output, weight is gained independent of the dietary macronutrient composition.^{7,8} However, strategies aimed at reducing obesity in America often target the need to eat less fat^{9,10} because it is more energy dense than carbohydrate. Spontaneous food consumption and total energy intake increases when the diet is high in fat and decreases when the diet is low in fat.^{7,11} Proponents of the Zone Diet and other low-carbohydrate diets argue that because data



show Americans growing more overweight while consuming less fat than ever before,¹² the fattening of America must result from an overemphasis on dietary carbohydrates, especially those with a high glycemic index (GI), which they claim may overstimulate the release of insulin and hasten the storage of fat and other nutrients.

Obesity is a disease often characterized by hyperinsulinemia. It is argued that eating carbohydrates, especially those with a high GI, promotes excessive insulin release (hyperinsulinemia), fat storage, and obesity.^{1,2} Many

Characteristics of the Zone Diet	YES	NO
Is false reasoning used (e.g., slippery-slope reasoning)?	✓	
Is testimonial/anecdotal evidence presented as empirical scientific evidence for efficacy?	✓	
Are the findings of available scientific studies misrepresented or misrepresented?	✓	
Are scientific theories or health governing agencies criticized?	✓	
Is the use of analogy or metaphor faulty?	✓	

plausible relationships among these physiological factors exist, but they do not necessarily represent a causal chain. Reference to such a causal chain of events (ie, carbohydrates raise insulin levels, which results in obesity; therefore, carbohydrates cause obesity) is an example of "slippery-slope" reasoning. Although some studies show the potential for high GI carbohydrates to increase body weight,¹³ many dietary factors influence and alter the GI, including the presence of protein, fat, fiber, and other common food components.¹¹ As a result, there has been a de-emphasis on the GI in the management of obesity and chronic disease.^{11,14} The pathophysiology of obesity is multifaceted and complex, but there is a simpler explanation for weight gain observed when fat intake is reduced, the first law of thermodynamics!

Although overfeeding fat remains a more efficient means of weight gain than overfeeding carbohydrate,⁸ the first law of thermodynamics cannot be circumvented. When energy intake exceeds energy expenditure, weight is gained regardless of the energy source.^{7,8} According to a recent US Department of Agriculture (USDA) survey of more than 16,000 Americans,¹⁵ fat intake (g/day) has not changed in the past 10 years. However, total energy intake has increased in concert with a decline in self-reported physical activity.¹⁵ In fact, 30%–45% of men and women report little or no daily exercise, which coincides with more than 50% of adults being overweight.¹⁵ The importance of physical activity to the energy balance equation is also underscored by the steep rise in obesity in Britain between 1980 and 1990, despite reductions in both fat intake and total energy intake during the same duration. Trends in obesity in Britain during that period were best tied to changes observed for number of cars per household and hours of television viewing.¹⁶ An analysis of data from the National Weight Control Registry concluded that the most successful long-term weight maintenance

strategy, even for men and women with extensive histories of overweight, was to eat fewer calories and increase physical activity.¹⁷

Zone Diet Proponents Rely on Anecdotes

Many of the Zone Diet's arguments are based solely on anecdotes. One example is the claim that adherence to the Zone Diet, rather than a more traditional diet high in carbohydrate, was responsible for propelling many collegiate swimmers to Olympic success.¹ Their path to the medal stand cannot be attributed to any single factor, nor can we even be certain that the Zone Diet played any role at all. Anecdotes are not science. At best, they are a mere springboard to scientific inquiry. The reliable evidence that does exist concerning nutrition and sports performance is diametrically opposed to the adoption of a Zone Diet.^{5,18,19} Specifically, endurance athletes require daily intakes of carbohydrate far in excess of Zone Diet recommendations to replace glycogen losses that reduce the ability to train and compete optimally at moderate to high exercise intensities.^{5,19}

Zone Diet Proponents Misinterpret Research

Zone Diet advocates wrongly interpret many studies that dispute its theories.^{1,20} The results of experiments showing equivalent effects of 40% and 80% carbohydrate diets on endurance performance,^{21,22} on the surface, support the Zone Diet concept and are portrayed as such by Zone Diet advocates.^{1,20} However, these studies provided considerably more energy (3500–4700 kcal/day) and carbohydrates (5–12 g/kg/day = 370–935 g/day) than even the highest Zone Diet recommendations for elite endurance athletes (Table 2). In another study,²³ Zone Diet proponents claim the diet²⁰ showed that a higher fat (38%) and lower carbohydrate (50%) diet enhanced oxygen uptake and improved endurance. This diet also provided 3500 kcal/day, 6.7g/kg/day carbohydrates (438g/day), and a P:C of .24. The experiment included more than double the carbohydrate content allotted in the Zone Diet (Table 2), was within the guidelines for optimal carbohydrate intake for endurance exercise (5–10 g/kg/day)²⁴, and resulted in a P:C ratio well below that in Zone Diet recommendations (.75). These diets are nothing like Zone Diets. In fact, the only study to ever explicitly examine the impact of the Zone Diet on exercise performance, although limited in its methodology, reported a 10% decline in endurance after only 7 days on the diet.²⁵

Zone Diet Proponents Criticize Federal Nutrition Guidance

Low-carbohydrate diet enthusiasts often attack federal food and nutrition policies aimed at reducing fat and

Fat (% kcal)	Weight (kg)	Body Fat (%)	Fat-Free Mass (kg)	Protein (g)	Carbohydrate (g)	Fat (g)	Energy (kcal)
30	64	7.5	60	130	173	55	1730
40	64	7.5	60	130	173	60	2020
60	64	7.5	60	130	173	202	3030

*Burden discussed in reference 5.
 †Although 5:22, 20:10, 30:10, 40:10, 60:10, 70:10, 80:10, 90:10, 100:10.

increasing carbohydrate intake. Zone Diet proponents contend that the federally recommended "healthy diet" (55% carbohydrate, 15% protein, and 30% fat) is "hormonally dead wrong" and has never been tested or proved to be healthy.^{1,26} Given the quantity and quality of research in support of contemporary diet recommendations but the difficulty with which the message is conveyed to the public, these remarks represent the epitome of public confusion and misinformation.

The Institute of Medicine (IOM) is one of the organizations operated by the distinguished National Academy of Sciences (NAS). Current dietary recommendations emerged primarily from reports published by its committees,⁹ as well as those issued by the Surgeon General⁴ and the USDA.¹⁰ These publications represent landmark achievements of rigorous scientific inquiry into nutritional approaches that reduce chronic disease. Although the long-term efficacy of adopting the Dietary Guidelines for Americans has never been tested, the validity and efficacy of its component recommendations for health were reviewed in a large cooperative effort organized by the American Heart Association.²⁷ Based on an extensive review of research and research-based recommendations already in place from numerous independent professional organizations, these guidelines were upheld and unified with remarkable agreement.²⁷ The National Nutrition Monitoring and Related Research Act of 1990 requires that the research on which the Dietary Guidelines for Americans is based be reviewed every 5 years and that revision be based only on current scientific evidence and medical knowledge.¹⁰ Therefore, even legitimate science-based recommendations are subject to change as our understanding of nutrient-health interactions improves. Although the public may view the dynamic nature of nutrition science as fickle or confusing, it is actually a fine example of the self-correcting nature of science at work. Knowing the difference between what is and what is *not* sound nutrition science is the key.

Zone Diet Proponents Argue Using False Analogy

Zone Diet advocates claim that the cattle industry has known for years that the best way to fatten cattle is to feed them copious quantities of grain.^{2,26} They conclude that the same fattening fate will befall people eating pasta and bagels because humans are similar to cattle.^{2,26} In fact, the monogastric anatomy and physiology of human beings is different from their ruminant cattle counterparts. Unlike humans, cattle are herbivores capable of extracting a considerable amount of energy from fiber. Cattle subsist on a forage-based diet (grass) for most of their lives, yet there is little difference between the marbling of meat in grain-fed or grass-fed animals, as long as grains or grain concentrates are limited to the finishing phase of meat production.^{28,29} In fact, the demand for leaner cuts of meat by health-conscious consumers has resulted in leaner cattle, even though carbohydrate remains the primary bovine dietary constituent. There are also unique differences in metabolism and the handling of macronutrients between ruminants and nonruminants³⁰ that make species comparisons inappropriate. The human-to-feed-lot cattle analogy succeeds in grabbing consumer attention, but it fails as a scientific argument.

Applications and Conclusions

Although adopting a Zone Diet is not harmful to health as are other more extreme low-carbohydrate diets,³¹ the diet is a rigid and restrictive eating regimen (a more elaborate interpretation of the Zone Diet as it relates to nutritional adequacy can be found elsewhere).³¹ More importantly, the diet's overblown health claims are based on dubious information and misinterpreted scientific facts and ultimately remain unsubstantiated.^{3,5} The burden of proof rests with the Zone Diet and other low-carbohydrate diet advocates in demonstrating through well-controlled

studies, rather than rhetoric, that a change in food and nutrition policy to restrict carbohydrates is truly warranted for improved health.

Acknowledgments

The views and findings in this report are those of the author and should not be construed as an official Department of the Army position, policy, or decision unless designated by other official documentation. This work was approved for public release; distribution is unlimited.

Samuel N. Cheuvront, PhD, RD, is a Research Physiologist at the US Army Research Institute of Environmental Medicine in Natick, Mass.

Corresponding author: Samuel N. Cheuvront, PhD, RD, US Army Research Institute of Environmental Medicine, 42 Kansas St, Natick, MA 01760-5007 (e-mail: Samuel.cheuvront@na.amedd.army.mil).

REFERENCES

1. Sears B. *The Zone*. New York: Harper Collins; 1995.
2. Sears B. *Mastering the Zone*. New York: Harper Collins; 1997.
3. Cheuvront SN. The Zone Diet phenomenon: a closer look at the science behind the claims. *J Am Coll Nutr*. 2003;22:9-17.
4. US Department of Health and Human Service, Public Health Service. The Surgeon General's Report on Nutrition and Health. Washington, DC: DHHS, 1988. Publication 88-50210.
5. Cheuvront SN. The Zone Diet and athletic performance. *Sports Med*. 1999;27:213-228.
6. Castellanos VH, Rolls BJ. Diet composition and the regulation of food intake and body weight. In: *Overweight and Weight Management*. Gaithersburg, Md: Aspen Publications; 1997:254-283.
7. Subbs RJ, Ritz P, Coward WA, et al. Covert manipulation of the ratio of dietary fat to carbohydrate and energy density: effect on food intake and energy balance in free-living men eating ad libitum. *Am J Clin Nutr*. 1995;62:330-337.
8. Horton TJ, Drougas H, Brachey A, Reed GW, Peters JC, Hill JO. Fat and carbohydrate overfeeding in humans: different effects on energy storage. *Am J Clin Nutr*. 1995;62:19-29.
9. National Academy of Sciences, National Research Council, Food and Nutrition Board. *Diet and Health: Implications for Reducing Chronic Disease Risk*. Washington, DC: National Academy Press; 1989.
10. US Department of Agriculture, Dietary Guidelines Advisory Committee. *The Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans*. Beltsville, Md: USDA Agricultural Research Service; 2000.
11. Franz MJ, Bantle JP, Beebe CA, et al. Evidence-based nutrition principles and recommendations for the treatment and prevention of diabetes and related complications. *Diabetes Care*. 2002;25:148-198.
12. Allred JB. Too much of a good thing? *J Amer Diet Assoc*. 1995;95:417-418.
13. Brand-Miller JC, Holt SH, Pawlak DB, et al. Glycemic index and obesity. *Am J Clin Nutr*. 2002;76:281S-285S.
14. Pi-Sunyer FX. Glycemic index and disease. *Am J Clin Nutr*. 2002;76:290S-298S.
15. US Department of Agriculture, Agricultural Research Service. *The 1994-96 Continuing Survey of Food Intakes by Individuals and the 1994-96 Diet and Health Knowledge Survey [CD-ROM]*. Springfield, Va: National Technical Information Service; 1998.
16. Prentice AM, Jebb SA. Obesity in Britain: gluttony or sloth? *Brit Med J*. 1995;311:437-439.
17. Klem ML, Wing RR, McGuire MT, Seagle HM, Hill JO. A descriptive study of individuals successful at long-term maintenance of substantial weight loss. *Am J Clin Nutr*. 1997;66:239-246.
18. Coleman EJ. Debunking the 'Eicotech' myth. *Sports Med Digest*. 1993;15:6-7.
19. Coleman EJ. The biozone nutrition system: a dietary panacea? *Int J Sports Nutr*. 1996;6:69-71.
20. Sears B. The Zone Diet and athletic performance [editorial]. *Sports Med*. 2000;29:289-294.
21. Lamb DR, Rinehardt KF, Bartels RL, Sherman WM, Snook JT. Dietary carbohydrate and intensity of interval swim training. *Am J Clin Nutr*. 1990;52:1058-1063.
22. Sherman WM, Doyle JA, Lamb DR, Strauss RH. Dietary carbohydrate, muscle glycogen, and exercise performance during 7 days of training. *Am J Clin Nutr*. 1993;57:27-31.
23. Muoio DM, Leddy JJ, Horvath PJ, Awad AB, Pendergast DR. Effect of dietary fat on metabolic adjustments to maximal VO₂ and endurance in runners. *Med Sci Sports Exerc*. 1994;26:81-88.
24. Sherman WM. Metabolism of sugars and physical performance. *Am J Clin Nutr*. 1995;6(suppl):228S-241S.
25. Jarvis M, McNaughton L, Seddon A, Thompson D. The acute 1-week effects of the Zone Diet on body composition, blood lipid levels, and performance in recreational endurance athletes. *J Strength Cond Res*. 2002;16:50-57.
26. The ZonePerfect Nutrition Company. Available at: http://www.zoneperfect.com/site/content/guide_02_ZoneDiet.asp. Accessed December 4, 2001.
27. Deckelbaum RJ, Fisher EA, Winston M, et al. Summary of a scientific conference on preventive nutrition: pediatrics to geriatrics. *Circulation*. 1999;100:450-456.
28. Muir PD, Deaker JM, Brown MD. Effects of forage and grain based feeding systems on beef quality: a review. *New Zeal J Agric Res*. 1998;41:623-635.
29. Keane MG, Allen P. Effects of production system intensity on performance, carcass composition and meat quality of beef cattle. *Livestock Production Sci*. 1998;56:203-214.
30. Bauman DE. Intermediary metabolism of adipose tissue. *Federation Proc*. 1976;35:2308-2313.
31. Anderson JW, Konz EC, Jenkins DJA. Health advantages and disadvantages of weight-reducing diets: a computer analysis and critical review. *J Amer Coll Nutr*. 2000;19:578-590.